

WHAT IS CLAIMED IS:

1. Apparatus for delivering a prosthesis into a target vessel comprising:
a flexible catheter shaft having proximal and distal ends and a first lumen
therein;
a tubular prosthesis releasably carried near the distal end of the catheter shaft,
the tubular prosthesis being expandable to a shape suitable for engaging the target vessel;
a sheath disposed over the catheter shaft and the tubular prosthesis and being
axially movable relative thereto, the sheath having proximal and distal ends and an exit port
between the proximal and distal ends; and
a guidewire tube extending through the exit port and having a distal extremity
disposed within the sheath and a proximal extremity disposed outside of the sheath, the
guidewire tube being adapted for slidably receiving a guidewire therethrough.
2. The apparatus of claim 1 wherein the guidewire tube is slidable
through the exit port.
3. The apparatus of claim 1 wherein the exit port is fluidly sealed around
the guidewire tube.
4. The apparatus of claim 1 wherein the guidewire tube is fixed relative
to the catheter shaft.
5. The apparatus of claim 1 wherein the sheath has a proximal portion
proximal to the exit port and a distal portion distal to the exit port, the proximal portion
having a smaller outer diameter than the distal portion.
6. The apparatus of claim 1 wherein the exit port is oriented so as to face
generally in a proximal direction.
7. The apparatus of claim 1 wherein the proximal extremity of the
guidewire tube is about 3-15 cm in length.
8. The apparatus of claim 1 wherein the guidewire tube has a proximal
end disposed a distance of less than about $\frac{1}{2}$ the length of the catheter shaft from the distal
end thereof.

9. The apparatus of claim 1 wherein the tubular prosthesis is self-expanding.

10. The apparatus of claim 9 wherein the sheath constrains expansion of the tubular prosthesis and is retractable to allow the tubular prosthesis to expand.

11. The apparatus of claim 1 further comprising an expandable member mounted to the catheter shaft near the distal end thereof, the tubular prosthesis being positionable over the expandable member for expansion therewith.

12. The apparatus of claim 11 wherein the expandable member comprises a balloon having an interior, the inner lumen in the catheter shaft being in communication with the interior for delivery of inflation fluid thereto.

13. The apparatus of claim 12 wherein the guidewire tube extends through the interior of the balloon.

14. The apparatus of claim 11 wherein the sheath is axially positionable relative to the expandable member and configured to restrain expansion of a selected portion of the expandable member.

15. The apparatus of claim 14 wherein the sheath is reinforced to prevent expansion thereof by the expandable member.

16. The apparatus of claim 1 wherein the tubular prosthesis comprises a plurality of prosthesis segments.

17. The apparatus of claim 16 wherein the sheath is axially movable relative to the prosthesis segments and configured to restrain expansion of a selectable number of prosthesis segments.

18. The apparatus of claim 1 further comprising a pusher slidably disposed over the catheter shaft within the sheath, the pusher having a distal end in engagement with the tubular prosthesis for moving the tubular prosthesis relative to the catheter shaft or the sheath.

19. A method of delivering a prosthesis in a target vessel of a patient comprising:

inserting a guidewire through the patient's vasculature to the target vessel; slidably coupling a delivery catheter to the guidewire, the delivery catheter having a sheath and a guidewire tube, a proximal extremity of the guidewire tube being outside the sheath and a distal extremity of the guidewire tube being inside the sheath, the guidewire being slidably positioned through the guidewire tube; advancing the delivery catheter over the guidewire to the target vessel; retracting the sheath relative to the guidewire tube to expose a tubular prosthesis carried by the delivery catheter; and expanding the tubular prosthesis into engagement with the target vessel.

20. The method of claim 19 wherein the guidewire tube extends through an exit port in a sidewall of the sheath and retracting the sheath comprises sliding the guidewire tube through the exit port.

21. The method of claim 20 further comprising sealing the exit port around the guidewire tube to restrict fluid flow therethrough.

22. The method of claim 19 wherein the delivery catheter further includes a catheter shaft, the sheath being slidably disposed over the catheter shaft, and wherein retracting the sheath comprises moving the sheath relative to the catheter shaft.

23. The method of claim 22 wherein the delivery catheter further comprises an expandable member fixed to the catheter shaft, the tubular prosthesis being positionable over the expandable member, and wherein expanding the tubular prosthesis comprises expanding the expandable member.

24. The method of claim 23 further comprising covering a proximal portion of the expandable member by the sheath to constrain the proximal portion from expansion while a distal portion of the expandable member expands.

25. The method of claim 23 wherein the expandable member is inflatable, further comprising delivering inflation fluid to the expandable member through an inflation lumen in the catheter shaft.

26. The method of claim 23 wherein the expandable member has an interior, the guidewire tube extending through the interior.

27. The method of claim 23 wherein the tubular prosthesis comprises a plurality of prosthesis segments, further comprising positioning a first selected number of the prosthesis segments on the expandable member for expansion therewith.

28. The method of claim 27 further comprising positioning the sheath over a second selected number of the prosthesis segments to constrain expansion thereof.

29. The method of claim 27 wherein the delivery catheter further comprises a pusher slidably disposed within the sheath, and wherein positioning the first selected number of prosthesis segments comprises pushing the first selected number with the pusher.

30. The method of claim 19 wherein the tubular prosthesis self-expands when the sheath is retracted.

31. The method of claim 19 wherein the proximal extremity of the guidewire tube has a proximal end disposed a distance of less than about $\frac{1}{2}$ the length of the sheath from a distal end thereof, the guidewire extending out of the proximal end.

32. The method of claim 20 wherein the exit port is oriented to face in a generally proximal direction such that guidewire tube slides axially through the exit port.

33. A balloon catheter for treating a target vessel comprising:
a flexible catheter shaft having proximal and distal ends and a first lumen therein;
an expandable member connected to the catheter shaft;
a sheath disposed over the catheter shaft and the expandable member and being axially movable relative thereto, the sheath having proximal and distal ends and an exit port between the proximal and distal ends; and
a guidewire tube extending through the exit port and having a distal extremity disposed within the sheath and a proximal extremity disposed outside of the sheath, the guidewire tube being adapted for slidably receiving a guidewire therethrough.

34. The apparatus of claim 33 wherein the guidewire tube is slidable through the exit port.

35. The apparatus of claim 33 wherein the exit port is fluidly sealed around the guidewire tube.

36. The apparatus of claim 33 wherein the guidewire tube is fixed relative to the catheter shaft.

37. The apparatus of claim 33 wherein the sheath has a proximal portion proximal to the exit port and a distal portion distal to the exit port, the proximal portion having a smaller outer diameter than the distal portion.

38. The apparatus of claim 33 wherein the exit port is oriented so as to face generally in a proximal direction.

39. The apparatus of claim 33 wherein the proximal extremity of the guidewire tube is about 3-15 cm in length.

40. The apparatus of claim 33 wherein the guidewire tube has a proximal end disposed a distance of less than about $\frac{1}{2}$ the length of the catheter shaft from the distal end thereof.

41. The apparatus of claim 33 further comprising a tubular prosthesis disposed on the expandable member.

42. The apparatus of claim 41 wherein the tubular prosthesis comprises a plurality of unconnected stent segments.

43. The apparatus of claim 42 wherein the stent segments are slidable relative to the expandable member.

44. The apparatus of claim 42 wherein the sheath is positionable to expose a first selected portion of the stent segments while covering a second selected portion of the stent segments.

45. The apparatus of claim 33 wherein the expandable member comprises a balloon, the balloon being in fluid communication with the first lumen to receive inflation fluid therefrom.

46. The apparatus of claim 33 wherein the sheath is positionable to constrain a first selected portion of the expandable member from expansion while a second selected portion of the expandable member expands.

47. Apparatus for delivering a prosthesis into a target vessel comprising:
a flexible catheter shaft having proximal and distal ends;
a tubular prosthesis slidably coupled to the catheter shaft, the tubular prosthesis being expandable to a shape suitable for engaging the target vessel;
a pusher for moving the tubular prosthesis from a pre-deployment position to a deployment position near the distal end of the catheter shaft; and
a stop on the catheter shaft configured to engage the tubular prosthesis when the tubular prosthesis is in the deployment position.

48. The apparatus of claim 47 further comprising an expandable member coupled to the catheter shaft, the deployment position being on the expandable member, the tubular prosthesis being adapted for expansion by the expandable member.

49. Apparatus of claim 48 wherein expandable member has an interior, the stop being disposed within the interior of the expandable member.

50. Apparatus of claim 47 further comprising a plurality of tubular prostheses slidably coupled to the catheter shaft and being movable by the pusher to the deployment position.

51. Apparatus of claim 47 further comprising a sheath movably coupled to the catheter shaft and positionable over the tubular prosthesis.

52. A method of deploying a tubular prosthesis in a target vessel, the method comprising:

positioning a catheter shaft in the target vessel;

moving the tubular prosthesis distally relative to the catheter shaft while the catheter shaft remains in the target vessel until the prosthesis engages a stop near the distal end of the catheter shaft; and

expanding the tubular prosthesis to engage a wall of the target vessel.

53. The method of claim 52 further comprising, after expanding the tubular prosthesis, moving a second prosthesis distally relative to the catheter shaft until the second prosthesis engages the stop, and expanding the second prosthesis to engage a wall of the target vessel.

54. The method of claim 52 further comprising moving a second prosthesis distally relative to the catheter shaft simultaneously with moving the tubular prosthesis, and expanding the second prosthesis and the tubular prosthesis together to engage the wall of the target vessel.

55. The method of claim 52 further comprising retaining a second prosthesis in an unexpanded configuration on the catheter shaft while the tubular prosthesis is expanded.

56. The method of claim 55 wherein the second prosthesis is retained within a sheath movably coupled to the catheter shaft.

1 57. The method of claim 52 wherein the tubular prosthesis is expanded by
2 inflating a balloon coupled to the catheter shaft.

1 58. The method of claim 52 wherein the tubular prosthesis is moved by a
2 pusher movably coupled to the catheter shaft.